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Tumbler Ridge Alternative Financing Mechanisms for Energy-Efficient Housing

Research Report

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TUMBLER RIDGE

ALTERNATIVE FINANCING MECHANISMS

FOR ENERGY-EFFICIENT HOUSING

A Study
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by

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1.0 INTRODUCTION

Tumbler Ridge is a new town in North-Eastern British Columbia which is being created to house workers of the new coal mines which are part of the massive North-East Coal Project. Since Tumbler Ridge is a new town, its planning represents both some unique challenges and some unique opportunities. The challenges concern such matters as how to finance the start-up municipal infrastructure costs, how to provide basic services during the initial phases of community growth, and many others. One unique opportunity which has received considerable attention is that of applying modern community planning techniques in a comprehensive fashion to a new community. Tumbler Ridge provides planners an opportunity to design on a community-wide scale without the usual constraints imposed by existing development.

As part of the broader planning process, energy use at Tumbler Ridge is receiving explicit attention. The Saskatchewan Research Council has studied alternative methods of making housing at Tumbler Ridge more energy efficient. In their reports they have identified four alternative levels of energy efficiency and projected the added capital costs and fuel savings associated with each level.

The Energy Conservation Branch of the British Columbia Ministry of Energy, Mines and Petroleum Resources has asked Edwin, Reid & Associates to examine the four energy efficiency levels to determine (1) which levels of added investment are economically viable, and (2) how the preferred level of energy efficiency investment might be financed in the current economic climate with its high interest rates.

This report is the result of that analysis. It contains economic analyses of each of the four alternative energy efficiency levels as applied to six different types of housing for three types of heating. Following the identification of the most economic option, possible financing mechanisms are reviewed. Financing mechanisms used in other jurisdictions are described and the implications of using different financing methods at Tumbler Ridge are explored.

Section 2 of this report presents the four alternative energy efficiency levels identified by the Saskatchewan Research Council. Section 3 describes the forecasts of residential rates for gas (with standard and with high efficiency furnaces) and electricity at Tumbler Ridge for the 25 year period used in the economic analysis. Section 4 reports the findings of the economic analysis. Section 5 describes financing alternatives used to promote investments in energy efficiency in other jurisdictions. Section 6 provides an examination of appropriate means for financing energy efficient housing at Tumbler Ridge.

2. LEVELS OF ENERGY EFFICIENT HOUSING

In its analyses (see Bibliography) the Saskatchewan Research Council (SRC) identifies four basic alternative levels of energy efficiency and some minor variations. The essential features of each (as applied to detatched dwellings) are listed below (taken from the SRC report).

1. "1975 Standard"

   This applies to current residential standards of construction.

   - Ceiling insulation
   - Wall insulation RSI 2.1
   - Foudations wall insulation zero
   - Slab insulation zero
   - Vapour barrier, standard 2-mil polyethylere construction
   - Roof trusses, standard hip
   - No air management
   - No passive solar design

2. "Measures"

   As recommended by the National Research Council in its 1980 publication.

   Measures #1

   - Ceiling insulation RSI 5.6
   - Wall insulation RSI 3.5
   - Foundation wall insulation RSI 1.5 over top 1200 mm
   - Slab insulation zero
   - Roof trusses have 57 mm heel
   - Wall is 38 x 140 studs x 600 mm on centres
   - Foundation stud frame is 38 x 38 x 600 mm on centres
   - Vapour barrier is standard 2-mil polyethylene, with some attention to sealing around doors and windows
   - No air management
   - Passive solar design

Measures #2:

- Walls with 38 x 89 studs on 400 mm centres
- Wall insulation is RSI 2.1 batt in stud frame with RSI 1.3 Styrofoam SM sheathing, 38 mm thick

Measures #3:

- Same except the foundation wall insulation is carried to the footing.

3. "Retro Ready"

This design is termed retrofit-ready because it concentrates on those aspects which will be difficult to retrofit at a later date. Other featuers, such as the ceiling insulation and the foundation insulation, are give less priority.

Retrofit-Ready #1:

- Ceiling insulation RSI 7.1
- Wall insulation RSI 4.9
- Foundation wall insulation RSI 1.3, full height
- Slab insulation zero
- Roof trusses have 89 mm heel
- Wall structure is 38 x 140 stud frame x 600 mm on centres, with vapour barrier, plus 38 x 64 horizontal strapping, on edge. Vapour barrier is buried in wall to protect against damage.
- Foundation wall insulation is 38 mm Styrofoam SM on exterior.
- Airtight vapour barrier construction, with 6-mil polyethylene.
- Simple air management system
- Triple glazing on non-solar windows
- 19 mm airspace double glazing on solar windows
- Passive solar design

Retrofit-Ready #2:

- Basically the same as R-R #1, execpt that the wall is sheathed with 38 mm Styrofoam SM to bring the total thermal resistance up to RSI 6.2.

4. "Super Energy Efficient"

This design is base on the Energy Showcase project in Saskatoon, 1980.

SEE #1:

- Ceiling insulation RSI 10.6
- Wall insulation RSI 7.0
- Foundation wall insulation RSI 3.9
- Roof trusses are cantilever design.
- Wall structure is 38 x 89 outer frame, 600 mm on centres, with 38 x 89 innter frame x 600 mm on centres. Three layers of glass fibre batt.
- Foundation wall has 38 mm, RSI 1.3 Styrofoam SM on exterior and 38 x 89 stud frame on interior, set-back to allow two cross-lapped layers of insulation.
- Slab has 6-mil polyethylene moisture/vapour barrier and 25 mm Styrofoam SM insulation.
- Airtight vapour barrier construction.
- Air management system with heat exchanger.
- Windows are RSI 0.57 triple glazed throughout.
- Doors ar thermal units.
- Passive solar design.

SEE #2:

- Basically the same as SEE #1, but the slab insulation is increased to 50 mm Styrofoam SM (RSI 1.8).

For purposes of analysis SRC examined the application of each of the above four levels of energy efficiency to the seven types of housing proposed for Tumbler Ridge:

1. 100 square metre detached
2. 80.6 square metre detached
3. 96 square metre duplex
4. 75 square metre duplex
5. 54 square metre row
6. 38.4 square metre apartment
7. 91 square metre prebuilt

For each efficiency-level/housing-type combination SRC carried out a heat loss analysis as a basis for estimating the energy requirements for space heating. SRC also provides estimates of the incremental costs associated with each efficiency-level/housing-type combination. The incremental costs of higher energy efficiency levels are reported below in Table 2.1. It should be noted that these costs represent the minimum costs that could be expected under highly competitive conditions.

TABLE 2.1

INCREMENTAL COSTS OF HIGHER ENERGY EFFICIENCY LEVELS

	DETACHED		SEMI-DETACHED		ROW	APTMT	PRE-BUILT
	100 SQM	80.6 SQM	96 SQM	75 SQM	54 SQM	38.4 SQM	91 SQM
1975 STD.	0	0	0	0	0	0	0
MEAS #1	1,512	1,320	1,257	1,051	589	305	1,192
MEAS #2	1,528	1,335	1,270	1,062	581	310	
MEAS #3	1,994	1,753	1,609	1,362	N.A.	N.A.	1,525
R.R. #1	4,479	3,960	2,826	3,161	2,491	1,197	
R.R. #2	4,939	4,374	4,167	3,458	2,619	1,308	
SEF #1	10,804	9,634	9,371	8,160	5,729	3,361	
SEF #2	11,233	9,973	9,783	8,474	5,968	N.A.	

SRC also examines the possibility of using newer, more efficient, gas furnace designs. The alternatives identified are (1) a standard furnace with 60% efficiency and (2) an improved design furnace with 70% efficiency costing $350 more.

Another factor which may influence space heating practices at Tumbler Ridge is the availability and popularity of wood burning stoves. Some enclosed models can produce substantial amounts of heat, and the ready accessibility of wood in the Tumbler Ridge area suggests that wood burning could account for a significant portion of space heating at Tumbler Ridge. However, there are indications that wood burning is not an economical means of meeting space heating requirements if one must pay to have the wood cut, split, delivered, and stacked. Furthermore, if wood is burned in a fireplace rather than an enclosed stove, it is likely that more heat will be carried up the chimney than is generated from the wood. Therefore, although it seems likely that many households will burn wood for heat, this source is not incorporated into the analyses in this study.

There are numerous construction techniques which might be employed at Tumbler Ridge which would affect the level of energy efficiency. One example is the possible use of treated wood instead of concrete for foundations. Consideration of these possibilities is beyond the scope of this study. Our analyses focus on those options identified by the Saskatchewan Research Council as appropriate for Tumbler Ridge.

3.0 GAS AND ELECTRICITY PRICE FORECASTS

The benefits which can justify incremental costs which improve the energy efficiency of houses are the fuel savings which result. To estimate these fuel savings for comparison with the associated costs, one must have an estimate of future heating fuel prices. The two types of fuel which we were asked to examine in this study are electricity and natural gas.

The prices of both of these fuels have increased substantially in recent years in both real and nominal terms.* Several factors have contributed to these increases. One factor is the general increase in energy prices attributed to the oil pricing policies of O.P.E.C. A second factor is the higher costs of newer forms of energy, whether it be more remote hydroelectric projects, deeper oil and gas wells, coal-fired plants with environmental protection, or nuclear energy. A third factor is the desire of governments to obtain higher revenues from energy use. A fourth factor is policies designed to improve economic incentives for appropriate energy use by setting energy prices closer to the social opportunity cost of energy provision.

The combination of these factors has resulted in significant price increases in recent years and will result in additional increases, in real terms, in the next two or three years. Once that adjustment is completed, it is anticipated that the real price of gas and electricity will be relatively stable, perhaps increasing at a rate of one percent per year. Forecasts for gas and electricity prices reflecting significant increases during the next few years

* An increase in real terms means the price has gone up faster than the general price level (i.e. faster than the rate of inflation).

followed by relative stability are presented in Tables 3.1 and 3.2. The real rates of increase are presented in Table 3.3. These price forecasts are employed in the analyses which follow in Section 4.

TABLE 3.1

ELECTRICITY PRICE FORECAST ($/GJ)

YEAR	INFLN RATE %	PRICE INDEX	ELECTRICITY REAL	NOMINAL
1981	12.00	0.89	9.60	8.57
1982	12.00	1.00	11.65	11.65
1983	11.80	1.12	12.25	13.70
1984	11.60	1.25	12.80	15.97
1985	11.40	1.39	13.35	18.56
1986	11.20	1.55	13.90	21.48
1987	11.00	1.72	13.90	23.85
1988	10.80	1.90	13.90	26.42
1989	10.60	2.10	13.90	29.22
1990	10.40	2.32	13.90	32.26
1991	10.20	2.56	13.90	35.55
1992	10.00	2.81	13.90	39.11
1993	9.80	3.09	13.90	42.94
1994	9.60	3.39	13.90	47.06
1995	9.40	3.70	13.90	51.49
1996	9.20	4.04	13.90	56.22
1997	9.00	4.41	13.90	61.28
1998	9.00	4.81	13.90	66.80
1999	9.00	5.24	13.90	72.81
2000	9.00	5.71	13.90	79.37
2001	9.00	6.22	13.90	86.51
2002	9.00	6.78	13.90	94.29
2003	9.00	7.39	13.90	102.78
2004	9.00	8.06	13.90	112.03
2005	9.00	8.79	13.90	122.11
2006	9.00	9.58	13.90	133.10
2007	9.00	10.44	13.90	145.08
2008	9.00	11.38	13.90	158.14
2009	9.00	12.40	13.90	172.37
2010	9.00	13.52	13.90	187.89

TABLE 3.2

GAS PRICE FORECAST ($/GJ)

YEAR	TOTAL WHOLESALE PRICE INCREASE		RETAIL PRICE - REAL			RETAIL PRICE - NOMINAL		
	REAL	NOMINAL	FIRST 1 GJ	NEXT 9.5 GJ	ADDNL GJ	FIRST 1 GJ	NEXT 9.5 GJ	ADDNL GJ
1981			4.62	3.42	2.91			
1982	0.55	0.55	5.17	3.97	3.46	5.17	3.97	3.46
1983	0.78	0.87	5.40	4.20	3.69	6.04	4.70	4.13
1984	0.99	1.24	5.61	4.42	3.91	7.00	5.51	4.87
1985	1.16	1.61	5.78	4.58	4.07	8.03	6.37	5.66
1986	1.40	2.16	6.02	4.82	4.31	9.30	7.45	6.66
1987	1.42	2.44	6.04	4.84	4.33	10.37	8.31	7.44
1988	1.45	2.76	6.07	4.87	4.36	11.54	9.26	8.30
1989	1.49	3.13	6.11	4.91	4.40	12.84	10.32	9.25
1990	1.53	3.54	6.15	4.95	4.44	14.26	11.48	10.30
1991	1.54	3.95	6.16	4.97	4.46	15.77	12.70	11.40
1992	1.57	4.41	6.19	4.99	4.48	17.41	14.04	12.60
1993	1.59	4.91	6.21	5.01	4.50	19.18	15.48	13.91
1994	1.60	5.41	6.22	5.02	4.51	21.05	17.00	15.27
1995	1.62	6.01	6.24	5.04	4.53	23.12	18.69	16.80
1996	1.63	6.61	6.25	5.06	4.55	25.30	20.45	18.39
1997	1.64	7.21	6.26	5.06	4.55	27.58	22.30	20.05
1998	1.63	7.85	6.25	5.06	4.55	30.05	24.30	21.84
1999	1.64	8.59	6.26	5.06	4.55	32.79	26.52	23.84
2000	1.67	9.51	6.29	5.09	4.58	35.89	29.05	26.14
2001	1.68	10.47	6.30	5.10	4.59	39.22	31.77	28.59
2002	1.69	11.48	6.31	5.11	4.60	42.82	34.69	31.23
2003	1.70	12.58	6.32	5.12	4.61	46.74	37.88	34.11
2004	1.71	13.78	6.33	5.13	4.62	51.02	41.36	37.25
2005	1.72	15.07	6.34	5.14	4.63	55.66	45.13	40.65
2006	1.73	16.52	6.35	5.15	4.64	60.76	49.29	44.41
2007	1.74	18.11	6.36	5.16	4.65	66.34	53.83	48.51
2008	1.75	19.86	6.37	5.17	4.66	72.42	58.79	52.99
2009	1.76	21.77	6.38	5.18	4.67	79.06	64.20	57.88
2010	1.77	23.86	6.39	5.19	4.68	86.31	70.12	63.22

TABLE 3.3

ANNUAL REAL PRICE CHANGE (%)

YEAR	ELECT.	GAS
1981		
1982	21.35	18.89
1983	5.15	6.59
1984	4.49	5.84
1985	4.30	4.21
1986	4.12	5.88
1987	0.00	0.57
1988	0.00	0.69
1989	0.00	0.84
1990	0.00	0.83
1991	0.00	0.43
1992	0.00	0.52
1993	0.00	0.49
1994	0.00	0.19
1995	0.00	0.55
1996	0.00	0.26
1997	0.00	0.03
1998	0.00	-0.04
1999	0.00	0.14
2000	0.00	0.57
2001	0.00	0.37
2002	0.00	0.22
2003	0.00	0.20
2004	0.00	0.18
2005	0.00	0.12
2006	0.00	0.22
2007	0.00	0.22
2008	0.00	0.22
2009	0.00	0.21
2010	0.00	0.21

The prices given in the preceeding tables correspond to those charges in existing norther and interior communities served by Inland Natural Gas. The distribution costs at Tumbler Ridge will be significantly higher. If these distribution costs are passed onto the consumer, the average price per gigajoule in 1982 dollars will be close to $6.00 instead of $4.00. The B.C. Utliities Commission has proposed a price slightly above $6.00/GJ.

While Tumbler Ridge residents might initially save $6.00 per GJ of reduced energy consumption, if many residents reduced their consumption the revenues would not cover the capital costs of the distribution system. As a result, the price would have to be increased. The ultimate saving is the energy portion of the gas price (i.e. excluding charges to cover distribution costs). This energy cost is about $4.00 per gigajoule.

For the purpose of this study, we have used both the $4.00 and $6.00 price levels (in 1982 dollars). The sensitivity analyses show that both price levels yield similar conclusions regarding appropriate energy level and financing strategy.

4.0 ECONOMIC ANALYSIS OF ALTERNATIVE ENERGY EFFICIENCY LEVELS

The economic benefits from an investment which improves the energy efficiency of a residence is the resulting savings on fuel purchases. Whether an energy efficiency investment is economically justified depends on whether the fuel savings outweigh the cost of investment. The economic objective is to minimize the total cost of fuel plus energy saving investments. Therefore, we can identify the economically preferred energy efficiency level by adding the incremental cost of each efficiency level to the associated cost of fuel for space heating and comparing the sum across the alternative levels of energy efficiency. In this Section of the report we calculate the combined fuel and energy-conservation costs for each alternative.

One complexity which arises when attempting to combine fuel costs and incremental energy efficiency investments for comparison purposes is that the two component costs occur at different times. The energy efficiency investment costs must be incurred at the time of construction, while the fuel costs are spread out over the life of the dwelling. Since the value of money depends on when it is received (the "time value of money"), a correction must be made before the investment and fuel expenditures can be compared. The correction, known as discounting, consists of reducing the value of future receipts and expenditures according to a discount rate to obtain the equivalent present value. The resulting present values can be combined and compared. The discount rate is related to the cost of borrowing money and can be expressed either in "nominal" or "real" terms where "real" means adjusted for inflation. In the following analysis a "real" discount rate of 5 percent is used. A real rate of 5 percent is approximately 5 percent more than the

rate of inflation. Thus with inflation at 10 percent, a 5 percent real discount rate would be about 15 percent in nominal terms.

The incremental costs of the identified alternative levels of energy efficiency reported in Table 2.1 are reproduced in Table 4.1. Table 4.2 reports the amount of energy (in Gigajoules/year) required to heat the homes.

TABLE 4.1

INCREMENTAL COSTS OF HIGHER ENERGY EFFICIENCY LEVELS

	DETACHED		SEMI-DETACHED		ROW	APTMT	PRE-BUILT
	100 SQM	80.6 SQM	96 SQM	75 SQM	54 SQM	38.4 SQM	91 SQM
1975 STD.	0	0	0	0	0	0	0
MEAS #1	1,512	1,320	1,257	1,051	589	305	1,192
MEAS #2	1,528	1,335	1,270	1,062	581	310	
MEAS #3	1,994	1,753	1,609	1,362	N.A.	N.A.	1,525
R.R. #1	4,479	3,960	2,826	3,161	2,491	1,197	
R.R. #2	4,939	4,374	4,167	3,458	2,619	1,308	
SEE #1	10,804	9,634	9,371	8,160	5,729	3,361	
SEE #2	11,233	9,973	9,783	8,474	5,968	N.A.	

(IN ADDITION, A 70% EFFICIENT GAS FURNACE COSTS $350 MORE THAN A 60% EFFICIENT MODEL, INCLUDING INSTALLATION COSTS.)
(Source: Saskatchewan Research Council, 1982)

TABLE 4.2

ANNUAL AMOUNT OF NET ENERGY REQUIRED PER UNIT (GJ)

	DETACHED		SEMI-DETACHED		ROW	APTMT	PRE-BUILT
	100 SQM	80.6 SQM	96 SQM	75 SQM	54 SQM	38.4 SQM	91 SQM
1975 STD.	171	144	146	110	53	24	225
MEAS #1	103	85	91	64	36	17	113
MEAS #2	104	85					
MEAS #3	91	74					
R.R. #1	60	49	53	35	19	9	
R.R. #2	58	47	52	33	18	9	
SFE #1	22	17	21	10	6	2	

(Source: Saskatchewan Research Council, 1982)

The cost of providing this heat depends on the energy source used. The gas and electricity price forecasts reported in Section 3 are used to calculate total fuel cost estimates for each type of dwelling and energy efficiency level.

To compare the costs and benefits of different energy efficiency lavels, we need summary measures for costs and for benefits. The cost of improved energy efficiency can be measured by the dollar cost per GJ per year reduction in energy use. For example, if spending $1512 reduces annual energy consumption from 171 GJ to 103 GJ, the cost is 1512/(172-103) = $22.24/GJ. Since the expenditure occurs at the time of construction, this cost measure is a present value and no discounting is required. The costs in $/GJ for the energy efficiency options identified by SRC are presented in Table 4.3. The estimates are varied 10 percent and 20 percent for sensitivity analysis.

TABLE 4.3

COST OF ENERGY SAVINGS

USING ALTERNATIVE ENERGY EFFICIENCY LEVELS

	ENERGY EFFICIENCY EXPENDITURE ABOVE STD 75	ENERGY EFFICIENCY EXPENDITURE ABOVE PREV LEVEL	ENERGY USE TOTAL	ENERGY USE REDUCTN	DOLLAR EXPENDITURE PER GJ SAVED $/GJ	SENSITIVITY ANALYSIS +10%	SENSITIVITY ANALYSIS -10%	SENSITIVITY ANALYSIS +20%	SENSITIVITY ANALYSIS -20%
LARGE DETACHED:									
STD 75	0		171						
MEAS #1	1512	1512	103	68	22.24	24.46	20.01	26.68	17.79
MEAS #3	1994	482	91	12	40.17	44.18	36.15	48.20	32.13
R.R. #1	4479	2485	60	31	80.16	88.18	72.15	96.19	64.13
SEE #1	10804	6325	22	38	166.45	183.09	149.80	199.74	133.16
SMALL DETACHED:									
STD 75	0		144						
MEAS #1	1320	1320	85	59	22.37	24.61	20.14	26.85	17.90
MEAS #3	1753	433	74	11	39.36	43.30	35.43	47.24	31.49
R.R. #1	3960	2207	49	25	88.28	97.11	79.45	105.94	70.62
SEE #1	9634	5674	17	32	177.31	195.04	159.58	212.78	141.85
LARGE DUPLEX:									
STD 75	0		146						
MEAS #1	1257	1257	91	55	22.85	25.14	20.57	27.43	18.28
R.R. #1	3161	1904	53	38	50.11	55.12	45.09	60.13	40.08
SEE #1	9371	6210	21	32	194.06	213.47	174.66	232.88	155.25
SMALL DUPLEX:									
STD 75	0		110						
MEAS #1	1051	1051	64	46	22.85	25.13	20.56	27.42	18.28
R.R. #1	3161	2110	35	29	72.76	80.03	65.48	87.31	58.21
SEE #1	8474	5313	10	25	212.52	233.77	191.27	255.02	170.02
ROW:									
STD 75	0		53						
MEAS #1	589	589	36	17	34.65	38.11	31.18	41.58	27.72
R.R. #1	2491	1902	19	17	111.88	123.07	100.69	134.26	89.51
SEE #1	5968	3477	6	13	267.46	294.21	240.72	320.95	213.97
APARTMENT:									
STD 75	0		24						
MEAS #1	305	305	17	7	43.57	47.93	39.21	52.29	34.86
R.R. #1	1197	892	9	8	111.50	122.65	100.35	133.80	89.20
SEE #1	3361	2164	2	7	309.14	340.06	278.23	370.97	247.31
PRE-BUILT:									
STD 75	0		225						
MEAS #1	1192	1192	113	112	10.64	11.71	9.58	12.77	8.51

The benefit measure which corresponds to the above costs per GJ saved is the present value of the savings from reducing energy consumption by one GJ per year over the assumed 25 year life. This savings depends on (1) the present energy price level, (2) the real rate of energy price increases, and (3) the real discount rate. Based on the analysis in Section 3 an estimate of $127/GJ was computed for gas using a 1982 price of $4/GJ and a 70% efficient furnace. A 1982 gas price of $6/GJ would imply an energy conservation benefit rate of $190/GJ. A second estimate of $234/GJ was computed for electricity. Percentage variations from these figures were also used for sensitivity analysis.

Figure 4.1 portrays the energy conservations costs and benefits for each housing type and efficiency level combination. Figure 4.2 presents a sensitivity analysis for the small detached house.

While electricity is generally regarded as inappropriate for space heating due to its higher cost, it has the advantage of universal availability to supply lighting, electronic, and electro-mechanical appliances. Since the provision of gas or coal-fired heat will require additional distribution costs, electric heat is included in this evaluation of alternatives. The cost of electric space heating energy is calculated by multiplying the amount of energy required (from Table 4.2) by the cost of electric energy (from Table 3.2). While electric energy has a two-tier pricing system with the initial 550 kwh per two-month period costing more, we have used the lower "trailing" rate since the initial 550 kwh would be consummed for lighting and appliance purposes. Since electric heating appliances do not require venting of exhaust gases with the accompanying loss of heat, we assume that it is 100% efficient in providing space heating.

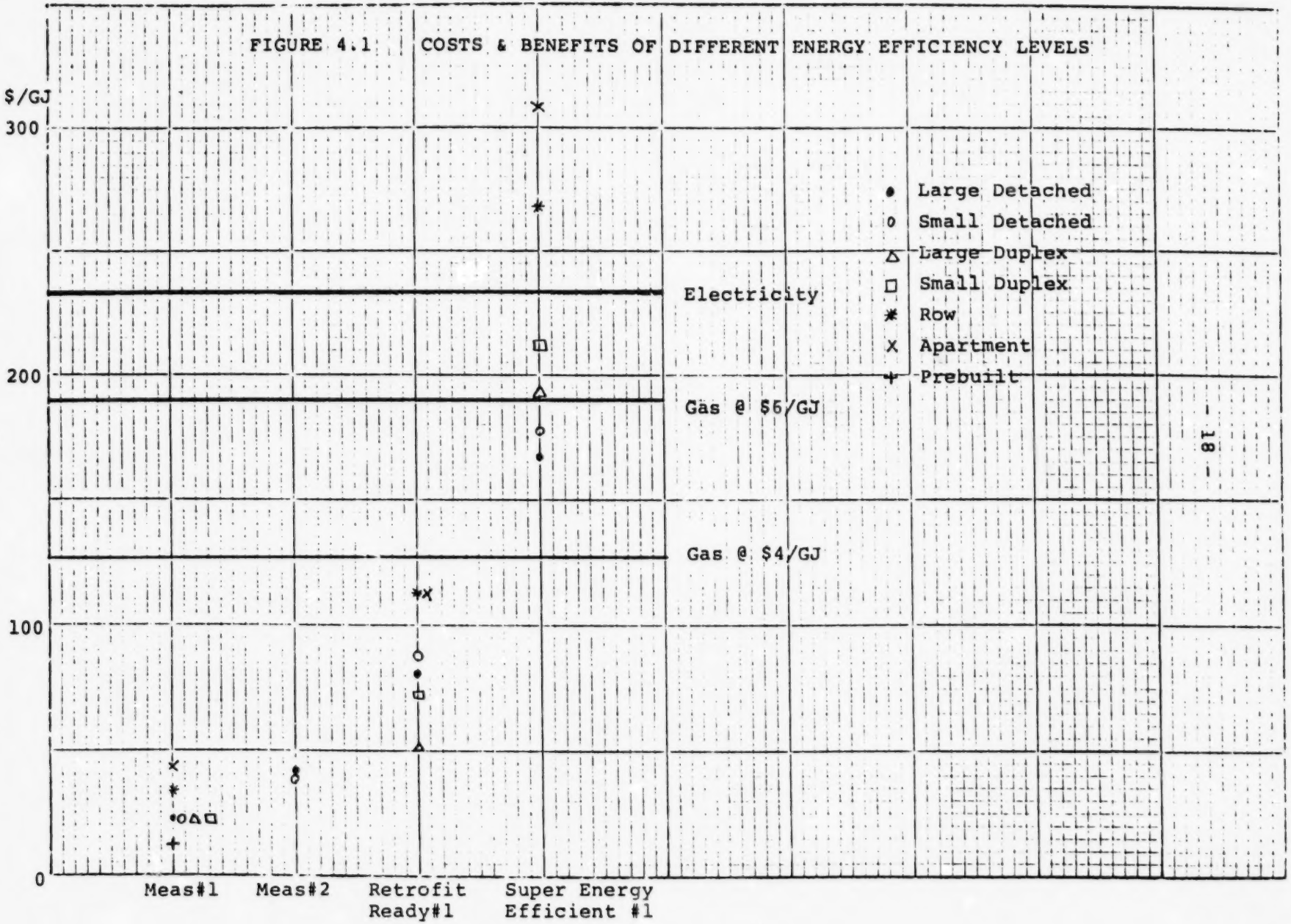
FIGURE 4.1 COSTS & BENEFITS OF DIFFERENT ENERGY EFFICIENCY LEVELS
$/GJ
300
200
100
0
Electricity
Gas @ $5/GJ
Gas @ $4/GJ
Large Detached
Small Detached
Large Duplex
Small Duplex
Row
Apartment
Prebuilt
Meas#1
Meas#2
Retrofit Ready#1
Super Energy Efficient #1

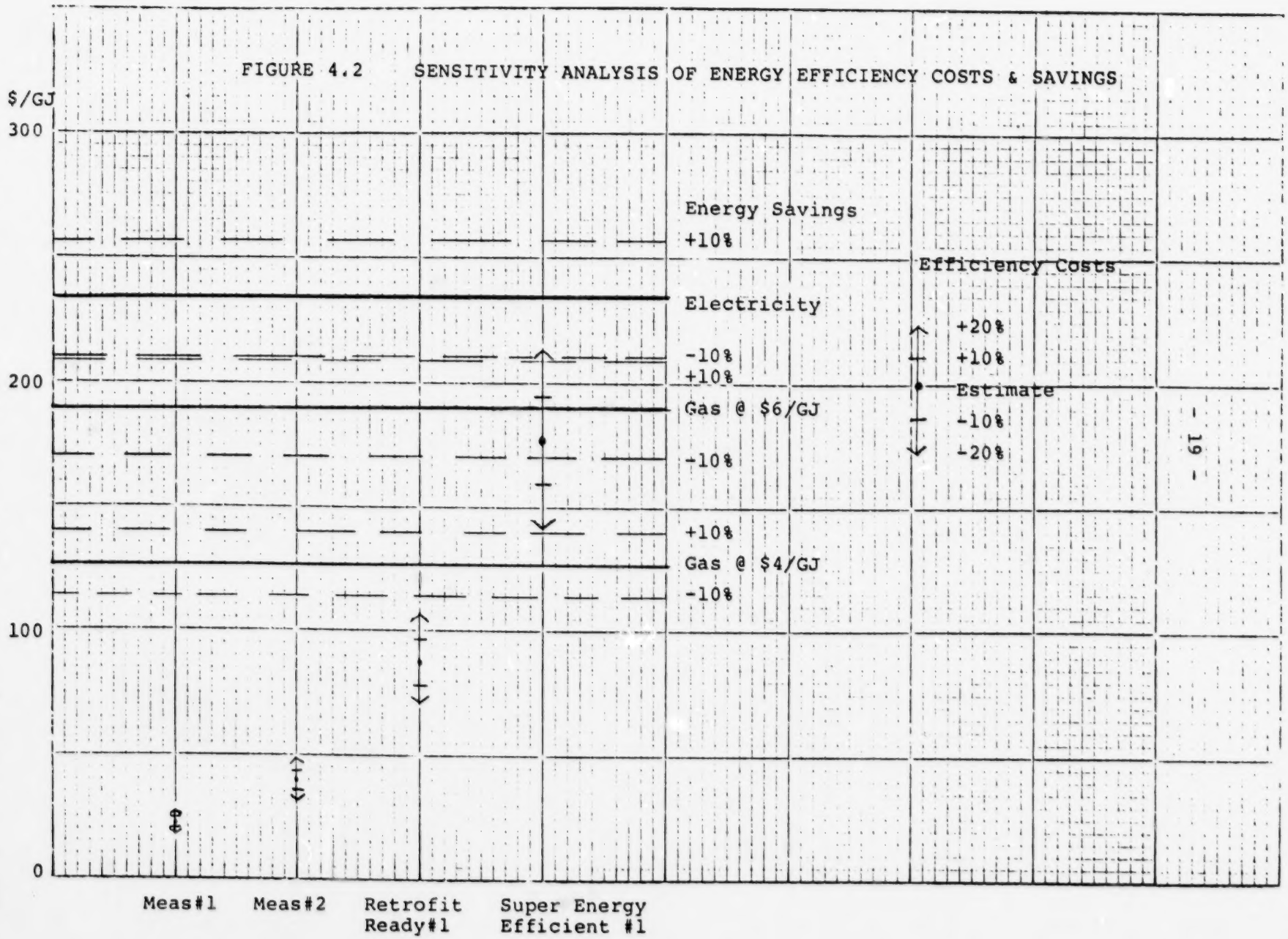
FIGURE 4.2 SENSITIVITY ANALYSIS OF ENERGY EFFICIENCY COSTS & SAVINGS
$/GJ
300
200
100
0
Energy Savings
+10%
Electricity
-10%
+10%
Gas @ $6/GJ
-10%
+10%
Gas @ $4/GJ
-10%
Efficiency Costs
+20%
+10%
Estimate
-10%
-20%
Meas#1
Meas#2
Retrofit Ready#1
Super Energy Efficient #1

The calculation of gas cost estimates is more complex than for electricity. Gas is sold with a three-tier price structure, and while the provision of domestic hot water will move the space-heating component up to the second price tier, fuel savings from higher levels of energy efficiency will be divided over two price levels. An additional complicating factor is that the price of reduced fuel consumption will depend on the time of year since higher heating requirements in the winter will place more consumers in the third price tier.

To account for the seasonality of gas consumption, the data in Table 4.4 on the percent of annual gas requirements consumed each calendar month were obtained from Inland Natural Gas (from Mr. Westler, Manager, Regulatory Affairs). The monthly amounts were collected into four groups with the averaged consumption amounts indicated in the table.

TABLE 4.4

SEASONALITY OF NATURAL GAS CONSUMPTION

MONTH	PERCENT OF ANNUAL CONSUMPTION	APPROXIMATION
January	17.11	16.23
February	12.96	12.04
March	11.18	12.04
April	7.25	7.49
May	4.38	3.29
June	3.16	3.29
July	2.65	3.29
August	2.75	3.29
September	3.53	3.29
October	7.72	7.49
November	11.97	12.04
December	15.34	16.23
Total	100.00	100.01

Figure 4.1 indicates that the Retrofit-Ready level of energy efficiency is justified for all types of houses even if gas prices are 10 percent below $4/GJ. With higher gas prices or electricity, the Super Energy Efficient option starts to look attractive for detached houses and duplexes.

To provide another perspective and to include an analysis of the desirability of the more efficient (70 percent) gas furnace, we calculated the present value of the total costs of (1) energy efficiency expenditure, and (2) fuel purchases for the 100 square metre detached house. The results are reported in Table 4.5.

TABLE 4.5

PRESENT VALUE OF

TOTAL COSTS OF ENERGY EFFICIENCY EXPENDITURE AND FUEL

FURNACE EFFICIENCY	EFFICIENCY LEVEL	EFFICIENCY EXPENDITURES	FUEL COSTS	TOTAL	RANK
60%	STD 75	$ 0	$23,987	$23,987	10
70%	STD 75	350	20,698	21,048	9
60%	MEAS #1	1,512	16,297	17,809	7
70%	MEAS #1	1,862	14,082	15,944	4
60%	MEAS #3	1,994	14,935	16,929	5
70%	MEAS #3	2,344	12,915	15,279	2
60%	R.R. #1	4,479	11,417	15,896	3
70%	R.R. #1	4,829	9,891	14,720	1
60%	SEE #1	10,804	7,048	17,852	8
70%	SEE #1	11,154	6,109	17,263	6

An examination of Table 4.5 reveals that (1) the investment in the higher efficiency furnace is justified in every case, and (2) the Retrofit-Ready option is the most cost effective.

A third approach is to calculate the energy price level for each energy efficiency level which results in that investment just breaking even (i.e. the benefits equal the costs in a present value sense). Table 4.6 reports breakeven energy price levels for a 100 square metre detached house.

TABLE 4.6

BREAKEVEN ENERGY PRICE LEVELS FOR ENERGY EFFICIENCY INVESTMENTS

(FOR 100 SQUARE METRE DETACHED HOUSE)

TYPE OF INVESTMENT	$/GJ	BREAKEVEN GAS PRICE 70% FURNACE	60% FURNACE
STD 75 TO MEAS #1	22.24	$ .70	$ .60
MEAS #1 TO MEAS #3	40.17	1.27	1.09
MEAS #3 TO R.R. #1	80.16	2.52	2.17
R.R. #1 TO SEE #1	166.45	5.24	4.50

The above analyses suggest that efforts should be focused on having the housing at Tumbler Ridge meet the Retrofit-Ready standards. If evidence appears that indicates that future energy costs will be higher than estimated in this report, future consideration should be given to Super Energy Efficiency for detached and possibly duplex housing units. Possible mechanisms for promoting Retrofit-Ready housing at Tumbler Ridge are examined in the following sections of this report.

5.0 ENERGY EFFICIENCY FINANCING ALTERNATIVES

There are several ways to finance the incremental cost of energy conservation features in housing units. The options include financing by:

1. Government
2. Financial Institutions
3. Resource Companies
4. Other interested parties

This section examines some existing programs and institutional factors as background for the analysis of financing alternatives at Tumbler Ridge presented in Section 6.

5.1 Government

Two government programs are examined in this review, one at the provincial level and the other at the municipal level.

As far as energy conservation programs go, the Government of Saskatchewan is in the forefront in Canada. Although other programs and projects are underway in that province, the Home Energy Loan Program is of particular relevance to our examination. The major objective of this program is to encourage the construction of energy efficient new houses by offering an incentive which will reduce the incremental cost of energy features to the purchaser. To date, these incremental costs have averaged approximately $3500. Implemented in July 1981, the program provides a $3000 interest-free loan repayable over 10 years to the first owner occupier of a new home. (Note: the loan is non-transferable and is secured by a promissory note). Processing of loans

and administration is carried out by Saskatchewan Power Corporation and following approval and disbursement of funds, the home-owner repays $25 in 120 consecutive installments on his monthly utility bill.

The thermal efficiency standards for the Home Energy Loan Program is almost identical to "Retrofit Ready". It is estimated that space heating requirements of the energy efficient homes are reduced by 70-75% over that of a home constructed at conventional standards. Builders wishing to have a housing unit certified under the Home Energy Loan Program apply for certification with the Saskatchewan Housing Corporation before beginning construction. Purchasers of units certified under the program must submit a loan application to the Saskatchewan Power Corporation. So far, the response to the program has been overwhelming and the Ministry of Energy estimates that fully 10% of all housing units constructed in the province since July have qualified for energy loans. Because the mortgage companies consider the $3000 loan as part of the downpayment, qualifying incomes have been minimized. (See TABLE 5.1). The effect of the incentive has been to cut the direct payback of the investment by approximately one-half to 5 years, a level the Ministry believes is attractive to the public.

The City of Portland, Oregon approved a comprehensive energy policy in August 1979. While its basic thrust at present involves retrofitting of existing residential units, by 1984 all housing units sold or rented in Portland must conform to stringent building code requirements. A non-profit corporation owned by the City has been charged with carrying out this ambitious program. In addition to operating as an information and marketing vehicle, the corporation has established a loan pool providing incentives on conservation

TABLE 5.1
HOME FINANCING & OPERATING COSTS

This table compares the costs of financing and operating homes built to various standards. For the Home Energy Loan Program Home it is assumed that the $3,000 interest free loan is used by the purchaser to increase his downpayment, and is repaid over 10 years in equal monthly installments.

	STANDARD HOME	HUDAC ENERGY SAVER HOME	LOW ENERGY HOME - UNASSISTED	HOME ENERGY LOAN PROGRAM HOME
Purchase Price	$55,000	$56,350	$58,535	$58,535
Downpayment (5%)	2,750	2,818	2,927	2,927
Loan	--	--	--	3,000
Total Downpayment	2,750	2,818	2,927	5,927
Mortgage *	53,034	54,335	56,440	53,397
PIT **	853	872	903	858
Heating Costs (Natural Gas)	46	26	13	13
Loan Repayment	--	--	--	25
Total Monthly Payment	899	898	916	896
Qualifying Income ***	$34,120	$34,880	$36,120	$34,320

* includes 1½% mortgage insurance fee.

** 18%/25 yr./$900 annual taxes.

*** 30% GDSR.

(SOURCE: THE SASKATCHEWAN HOME ENERGY LOAN PROGRAM)

loans for residential property owners. To date, the corporation has borrowed $15 million from local financial institutions. This amount has been supplemented by a $3 million grant from the U.S. Government to make these long-term loans available at a low interest rate. The Federal grant has allowed the corporation to subsidize the interest rate at 8%, with a term of 10 years. Since implementation, the average loan approval has been $3500 with an average monthly payback of $32. The corporation estimates average monthly energy savings to be $47.

We are not aware of any municipality that is involved in financing energy conservation programs in this country. Gary Paget of the Ministry of Municipal Affairs in Victoria feels that there would be no pecuniary benefit for a municipality in encouraging householders to save energy when the real benefits of energy efficient houses would accrue to homeowners and/or the provincial and federal governments.

5.2 Financial Institutions

Mortgage loans are granted primarily by chartered banks, trust companies, and credit unions and to a lesser extent by life insurance companies and savings and loan companies.

The Royal Bank of Canada has entered into an exclusive branch agreement with the Corporation of Tumbler Ridge which will exclude other chartered banks from establishing a branch in the townsite for several years. By no means does this exclusive agreement prevent other lending institutions from participating in mortgage lending but it certainly ensures that the Royal will be the

primary lender in the area. Telephone discussions with Bob Corlett, Manager of Mortgages, Main Branch, Vancouver, reveals that the bank would be willing to consider any incremental energy investment on a third mortgage basis as long as it is within the CMHC guidelines of total outside financing being less than 75% of purchase price. This would not appear to be a practical option since most housing units will not qualify for third mortgage financing. Gerry Conley, Manager of Retail Marketing, Regional Office, feels that any energy costs should be included in the first mortgage. The Royal does not get involved in graduated mortgage schemes.

Dennis Oram at BC Central Credit Union reports that local credit unions in Dawson Creek and Fort St. John have been approached to set up shop in Tumbler Ridge but they are not interested. It is felt that any branch in the town would not receive substantial deposits from residents but would only serve as a lender. Unlike banks, credit unions are autonomous and do not have large pools of capital to draw on thereby making a branch a risky proposition, at least at this point in time. Oram states that Credit unions do band together in order to make larger loans but this will only be considered for non-residential projects in the town, if at all.

Mike Smith, Regional Mortgage Manager, London Life Insurance Company, states that in B.C., London Life does not finance outside Greater Vancouver. He believes that 1982 is a tough year for residential lending in any case and mortgage lending is at the bottom of priority lists for most lenders. Good corporate guarantees or provincial government involvement is required in order to get affordable housing (with or without energy features) in place. As a lender he feels that most workers relocating to Tumbler Ridge, if they had a

choice, would not be interested in incurring incremental energy costs as they will likely want to move to the south after a couple of years and will therefore not benefit at all from potential fuel savings. To get any kind of financing at all will be the crucial problem according to Smith.

Mac McCulloch, Manager, BC and Yukon Region, Kinross Mortgage Corporatior says that Kinross will go along with whatever CMHC sets out in its guidelines although it does not consider graduated mortgage payments as a desireable concept. He feels that there is plenty of room for government incentives for both energy conservation designs and for creating affordable housing.

In a 1981 report on the Development of Energy Ffficient Housing Mark Stevenson, a planner with Ontario Hydro states that lending institutions believe the most important selling feature of a new house is the mortgage rate and the down payment. The banks expressed concern over developers (or in our case, mining companies) buying down the mortgage rate on new houses in order to make them more saleable. They feel that if a borrower purchased a house at 32 per cent GDS ratio on a bought down mortgage rate, then at renewal in three years, the energy saving may not be great enough to meet the potential increased monthly payments at the new mortgage rate (assuming mortgage rates remain high). The banks indicated that a house can be made more saleable if it requires a low down payment. However, the smaller the down payment the greater the risk of default on the mortgage. In short, the banks would not like to see lower down payments required for reduced energy houses as a means of making them more affordable, but they indicated that if the mortgage was insured they would provide the financing.

Since July 1981, the Canada Mortgage and Housing Corporation has required

lenders to consider space heating costs as well as principal, interest and taxes. At the same time, the maximum permissible shelter cost to income ratio was raised from 30% to 32%. As a result of this policy change in gross debt servicing, purchasers of new houses (which meet the standards announced in the National Energy Program as of July 1, 1981) qualify at slightly lower incomes whereas purchasers of energy inefficient housing need higher qualifying incomes. CMHC feels that this policy will act as an incentive to increase the energy efficiency of housing stock as well as reduce the risk of mortgage defaults due to heating costs claiming an excessive proportion of purchaser's income.

The Mortgage Insurance Company of Canada (MICC) which is the private competitor to CMHC has not as yet made energy costs a requirement although some lenders, in particular the Royal Bank, are utilizing this concept through MICC.

5.3 Resource Companies

Due to the sweeping changes proposed in the November Federal Budget pertaining to the taxation of employee benefits, officials at Teck and Denison Mines are unsure of the incentives to be offered in order to provide affordable housing for mine employees. In the past, resource companies have usually offered low or interest-free second mortgages. Other inducements have included guaranteed buy-back plans. As an example, Crow's Nest Resources Ltd. has a 20 year guaranteed plan for its coal mine employees in the Kootenays. It will guarantee to purchase a home at cost if an employee decides to sell within the first 2 years after purchase and will buy at market if sold during the next 18

years. Nevertheless, Derek Rance, Vice-President, Operations, Denison Mines Ltd. does not favour a guaranteed buy-back and it is unlikely that it will be offered at Tumbler Ridge. As Denison is the major player at Tumbler Ridge, Teck and any subsequent mines will endeavor to match whatever Denison offers its employees. Rance stated that the mining companies are desirous in encouraging home ownership for a variety of reasons not the least of which is their experience of reduced employee turnover.

From Denison's experience in other resource communities, fully 30% of mine employees cannot afford modest homes even with generous second mortgage subsidies provided by the companies. As a result, the task at Tumbler Ridge is a formidable one. Although the Federal Budget has cut the options of the resource companies to a considerable extent, Rance, while not revealing concrete plans, stated that the companies would find some method of providing affordable homes to its employees. In addition, the companies are exploring mechanisms for providing acceptable assurances to builders.

Terry Gibson, Housing Manager, Crow's Nest Resources in Fernie, B.C. feels that it is imprudent to allow graduated payments mortgages for its employees. Historically, miners are likely to be heavily encumbered with consumer loan payments for boats, trailers and durable goods and with today's volatile interest rates, he feels that allowing mortgages to increase is an irresponsible method of financing. Gibson reports that Crow's Nest has constructed 225 energy efficient housing units in Sparwood, B.C. over the last 15 months and several hundred more are contemplated in the next few years as employment is expected to increase dramatically. These homes are built to standards slightly higher than "Measures" with 2x6 construction, R12

insulation in basement walls, R20 in walls, and R40 in the ceiling. The incremental energy investment is estimated to be approximately $800. House prices in the area have increased considerably so employees do not have to worry about resale problems, at least for the forseeable future.

From his experience, Gibson states that mortgage rates over 16% causes a serious affordability problem. At that level, employees turn to rental units or to more modest homes. Presently 60% of workers in the area are homeowners, which he believes is an impressive number. If that figure were to fall to 50%, the companies would be concerned and would likely consider additional housing incentives.

The ramifications stemming from the Federal Budget and the uncertainty as to how the actual legislation will read has made it extremely difficult to get a reading on incentives that might be introduced. In order to entice workers to a new town in a fairly remote part of the province, the respective companies will have to offer hefty financial incentives as part of its overall package. This is especially true if the companies hope to attract personnel from coal mines in the Kootenays - a much more attractive area in terms of climate, topography, cost of living, and proximity to large urban centres i.e. Calgary, Spokane, and Vancouver.

David Rice, Director of Legislation and Research at the B.C. Federation of Labour says that labour is in the dark on this topic like everyone else. He believes that if the proposals are legislated, the unions will sit down with the individual companies in order to negotiate additional bonuses for the employees. For example, more money would be requested in order to increase

disposable income to replace the new amount taxed for fringe benefits. As well, employees would want additional amounts to pay for housing costs.

5.4 Other Interested Parties

In discussion with Doug Harwood and Jim Randall at Inland Natural Gas Company Ltd. it would appear that utility companies would not rule out consideration of some sort of energy financing scheme if it meant an approval from the Utilities Commission to service the area. At the present time there is no provision in Inland's tariff to finance insulation or any energy conservation features in new housing - only a provision for conversion from oil to natural gas furnaces. If the utility companies were to finance, they would require as security either a second mortgage or a lien. Because liens have to be renewed every 3 years, it is doubtful that the administrative headaches would be worth the bother of financing in the first place. In addition, since Inland must borrow at market rates to meet its capital requirements, they would not be able to finance at below-market rates.

Mr. Bunli Yang at the Conservation and Renewable Energy Branch of the Ontario Ministry of Energy has approached lending institutions as well as private lenders to guage their interest in financing energy conservation features. Unfortunately, his canvassing of lenders is in the initial stages and he was not prepared to fill us in on his results to date. Nonetheless, he is prepared to provide a copy of his findings to the Conservation and Renewable Energy Branch of the Ministry of Energy, Mines and Petroleum Resources.

5.5 The Market Appeal Of Energy Ffficiency

Jim Moodie of Moodie Consultants was project manager for the City of Vancouver community of Champlain Heights, which includes a 94 unit energy efficient housing project called Solar West. This project was set up as an unsubsidized market development in an effort to build energy efficient homes that could be successfully marketed and the first units were offered for sale in 1980. The name Solar West was chosen before planners concluded that the best way to reduce home heating bills was not through using active solar technology, but by relying on less complicated things such as insulation, better caulking, and double glazing. It is expected that the heating costs in Solar West homes will be reduced to $100 per year, down from the annual average of $500 for a conventional three bedroom home of comparable size (in this case 162 sq m). Walls were insulated to an R20 standard and ceilings to R38 which compare to the normal Vancouver standards of R12 and R22. These homes were strategically placed to take advantage of passive solar techniques, all have gas forced air heating systems with electronic ignition and continuous fans, all have efficient fireplaces and double door entrances. Moodie suggests that the added cost of approximately $3,500 for the energy-saving features are expected to pay for themselves in six or seven years through reduced heating bills.

Moodie maintains that from his experience, conservation and energy features are not going to sell houses on their own. The unfortunate reality in today's market is that energy costs are not significant during times of high mortgage rates. Consider that at current mortgage rates a 1/2 point increase on a $100,000 mortgage adds several hundred dollars to the annual cost of the unit. According to Moodie, the home purchaser is basically conservative and he is

not going to pay a whole lot more for things he cannot see. One lesson he learned was that you don't design and market solely for energy conservation or efficiency reasons. A clever design will incorporate features that have other functions or values such as an atrium, sun room, tile floor etc. As well, It is essential that we take the basic energy saving features and assemble them in a way that is efficient and appealing so that people will not have to adjust their lifestyles by sacrificing to be efficient.

Current literature and discussions with the real estate industry and financial institutions indicate that the British Columbia consumer is generally not overly concerned with reduced energy housing. A 1979 survey of real estate brokers and salespersons across Canada conducted by the Canadian Real Estate Association Reporter, found that although energy efficiency is a saleable feature for a house, the price, financing and location are the determining factors. Only Northern Ontarians seemed willing to pay more for reduced energy houses. (A Timmins broker indicated that buyers in that area were willing to pay 5 per cent more for energy efficient homes.) The buyer is unwilling to pay the extra efficiency costs possibly because he is unaware of the savings. The home purchaser's decision to buy would appear to be viewed as a short-term investment decision which is unaffected by the cost of energy. The buyer generally expects to sell within 4-5 years which in some cases precedes the ee payback term. Mike Maschek of Nu-West Development and a Director of HUDAC in B.C. reports that the average turnover of houses in Canada is decreasing. At present, turnover is once every 4 years although it is probably loWER in resource communities. Terry Gibson of Crow's Nest Resources in Fernie, B.C. reports that from his experience, the average turnover of renters in resource communities is about 15% per year compared to

5-10% for homeowners. These turnover rates are considerably less than the overall Canadian average which underscores the belief that turnover rates are in fact lower in resource centres.

A U.S. study conducted by Opinion Research Corp. found:

a) energy efficient homes are easier to sell

b) a well insulated house can be worth an average of up to 9 per cent more at resale

c) home buyers view insulation as the biggest money saver of energy saving features

d) it is becoming easier to finance an energy efficient home compared to homes lacking an energy saving system

With the advent of PITE, which is now a CMHC requirement, it appears as though the average Canadian will be forced to become more aware of the benefits and costs of energy efficiency. This awareness will also be critical at other levels i.e. especially for municipal officials and builders. For example, better construction techniques (especially in the area of better caulking and sealing) will lead to very significant improvements.

The Housing and Urban Development Association Of Canada (HUDAC) is promoting energy efficiency. HUDAC (together with CMHC) has undertaken a voluntary energy efficiency certification program for new houses constructed to meet specified levels of insulation and other requirements. As part of the program the two parties are conducting a study of 17 Canadian cities to calculate the payback period of energy efficient features. The target is a five-year payback.

6.0 FINANCING ENERGY EFFICIENCY AT TUMBLER RIDGE

The analysis reported in Section 4 indicates that the preferred option is the Retrofit-Ready level of energy efficiency combined with a 70 percent efficient furnace. This conclusion is dependant on the assumptions underlying the analysis. These assumptions involve the prices of different energy conserving components, their performance in reducing fuel consumption, future energy prices, and the future cost of capital. While the conclusion is dependent on these assumptions, the economic superiority of the Retrofit-Ready option is substantial enough that it would remain the preferred choice in spite of significant variations in the assumptions.

Given that the Retrofit-Ready level of energy efficiency combined with a 70 percent furnace is the preferred option, the remaining question is how financing for the incremental cost can be arranged so that the investment will not be discouraged by financial difficulties. To answer this question we must specify the character of the investment to be made. This will be followed by analysis of the available financing options.

The investment associated with the Retrofit-Ready level of energy efficiency and the 70 percent efficient furnace must be made at the time of construction. The return on this investment consists of reduced fuel bills over the life of the dwelling. For the 100 square metre detached dwelling, the cash flow is as follows:

TABLE 6.1

CASH FLOW OF ENFRGY EFFICENCY INVFSTMENT

Year	Cash Flow Current$	Cash Flow 1983$	Year	Cash Flow Current$	Cash Flow 1983$
0	-4479	-4479	13	3542	1024
1	874	874	14	3877	1022
2	1030	919	15	4227	1019
3	1196	955	16	4605	1016
4	1405	1006	17	5026	1018
5	1570	1008	18	5510	1024
6	1751	1011	19	6026	1027
7	1951	1015	20	6582	1029
8	2172	1020	21	7189	1031
9	2404	1021	22	7851	1033
10	2657	1022	23	8567	1034
11	2933	1024	24	9359	1037
12	3220	1022	25	10223	1039

The payback on this investment is four years. The net present value using a five percent real discount rate is $9617. The internal rate of return in nominal terms is 26.6 percent. The risk of the investment not paying off as well as projected is slight since the assumptions are conservative. The most likely way in which a lower return might be encountered would be as a result of gas prices falling in real terms. Many believe this is very unlikely.

By any measure, this is a respectable investment and one which any reasonable person should be happy to make, even if the investment funds must be borrowed. However, the prospective investors are individuals moving to Tumbler Ridge and buying a house. Recent high interest rates have caused a housing affordability crisis by sharply increasing the size of mortgage payments. These high mortgage payments reduce the size of mortgage for which a given income level will qualify, and impose severe cash flow requirements in the first years of the mortgage. In this environment, incremental energy efficiency investments will not be appealing if they significantly increase

cash flow requirements or jeopardize the purchasers' ability to qualify for a mortgage.

Factors affecting financing of energy efficiency at Tumbler Ridge have fluctuated dramatically during the conduct of this study.

1. Mortgage interest rates peaked above 20 percent before starting their present downward trend which has reached the thirteen percent level.

2. The estimates of (1) the incremental costs and (2) fuel savings benefits of different energy efficiency levels were revised significantly.

3. The B.C. Utilities Commission has held hearings and decided that natural gas would be supplied to Tumbler Ridge from local wells at a cost near $6 per gigajoule.

4. The chartered banks have introduced a number of new mortgage instruments aimed at (1) countering the impact of inflation induced high interest rates on the pattern of loan payments, (2) smoothing the impact of rapidly fluctuating interest rates on loan payments, and (3) shortening the term during which the interest rate is fixed.

5. The B.C. Government has introduced its new "Home Program" which provides an interest-free loan equal to the amount by which actual mortgage payments (on loans up to $60,000) exceed the level of a 12 percent loan.

6. The Federal Government has introduced and extended its $3000 grant to purchasers of new homes.

In this dynamic environment, it has been difficult to maintain a current analyss of appropriate financing techniques. Part of our approach has been to understand the characteristics of the financing requirements at Tumbler Ridge and examine alternatives appropriate for dealing with those characteristics. As will be shown in the following section the changes listed above (particularly interest rate levels and revised estimates of incremental costs and fuel savings) have significantly altered the financing requirements.

After an examination of the present financing requirements, a number of possible financing techniques will be examined. Some of these techniques would not be required under present conditions but could be adopted if (1) interest rates went back up, (2) future energy price forecasts were revised down, or (3) the costs of building in higher energy efficiency levels goes up.

6.1 Financing Requirements at Tumbler Ridge

While prospective house purchasers should employ present value criteria for evaluating incremental investments in higher energy efficiency, the criterion which will likely have the most impact on decisions is whether the savings from reduced fuel consumption are enough to pay the costs of financing the incremental energy efficiency. This "cash flow" criterion is influential because it is easier to understand than present value concepts and it describes the out-of- pocket implications at the time of house purchase when cash flow constraints are severe. Furthermore, due to the impacts of inflation on loan payment schedules, the cash flow criterion is most severe during the first year so that any investment which yields a positive cash flow in the first year will also satisfy present value criteria.

Table 6.2 presents an analysis of the cash flows associated with housing units with (1) the Retrofit-Ready level of energy efficiency and a 70% efficient furnace versus (2) the standard level of energy efficiency and a 60% efficient furnace. The analysis uses a 17 percent mortgage rate. While lower rates are now available and likely to continue, using a lower rates does not materially affect the conculsions. It is also assumed that the down payment is 10 percent of the price of the standard house so that 100 percent of the incremental energy efficiency investment is financed.

FINANCING OF HOUSING AND ENERGY SAVING INVESTMENT (FIRST YEAR)

ASSUMPTIONS:
INTEREST RATE: 17 PERCENT
DOWN PAYMENT: 10 PERCENT

	LOT COST	CONSTRN COST	EN SAVG INVEST	TOTAL COST	DOWN PAYMENT	FIRST AMOUNT	MORTGAGE PAYMENT	SECOND AMOUNT	MORTGAGE PAYMENT	SPACE HEATING	PROPTY TAXES	TOTAL PAYMENTS	QUAL INCOME
100 SQM DETACHED													
STD & 60% FURNCE	20000	61500		81500	8150	61125	10601	12225	2120	1496	1500	15717	49114
R-R #1 & 70% FRN	20000	61500	4829	86329	8150	64747	11229	13432	2329	622	1500	15680	49000
80.6 SQM DETACHED													
STD & 60% FURNCE	20000	49500		69500	6950	52125	9040	10425	1808	1308	1200	13356	41736
R-R #1 & 70% FRN	20000	49500	4310	73810	6950	55358	9600	11503	1995	554	1200	13349	41716
96 SQM SEMI-DETACH													
STD & 60% FURNCE	17000	53000		70000	7000	52500	9105	10500	1821	1322	1440	13688	42774
R-R #1 & 70% FRN	17000	53000	3176	73176	7000	54882	9518	11294	1959	579	1440	13495	42173
75 SQM SEMI-DETACH													
STD & 60% FURNCE	17000	42000		59000	5900	44250	7674	8850	1535	1069	1120	11398	35618
R-R #1 & 70% FRN	17000	42000	3511	62511	5900	46883	8131	9728	1687	468	1120	11406	35643
54 SQM ROW													
STD & 60% FURNCE	13000	22000		35000	3500	26250	4552	5250	910	668	810	6941	21690
R-R #1 & 70% FRN	13000	22000	2841	37841	3500	28381	4922	5960	1034	367	810	7133	22289
38.4 SQM APT													
STD & 60% FURNCE	8000	13000		21000	2100	15750	2731	3150	546	460	290	4028	12587
R-R #1 & 70% FRN	8000	13000	1547	22547	2100	16910	2933	3537	613	302	290	4138	12931
91 SQM PRE-BUILT													
STD & 60% FURNCE	17000	37000		54000	5400	40500	7024	8100	1405	1868	1365	11661	36442
R-R #1 & 70% FRN	17000	37000	1542	55542	5400	41657	7224	8486	1472	943	1365	11004	34387

TABLE 6.2

FINANCING OF HOUSING AND ENERGY SAVING INVESTMENT (THIRD YEAR)

ASSUMPTIONS:
INTEREST RATE: 17 PERCENT
DOWN PAYMENT: 10 PERCENT

	LOT COST	CONSTRN COST	EN SAVG INVEST	TOTAL COST	DOWN PAYMENT	FIRST AMOUNT	MORTGAGE PAYMENT	SECOND AMOUNT	MORTGAGE PAYMENT	SPACE HEATING	PROPTY TAXES	TOTAL PAYMENTS	QUAL INCOME
100 SQM DETACHED													
STD & 60% FURNCE	20000	61500		81500	8150	61125	10601	12225	2120	1870	1500	16091	50283
R-R #1 & 70% FRN	20000	61500	4829	86329	8150	64747	11229	13432	2329	778	1500	15836	49486
80.6 SQM DETACHED													
STD & 60% FURNCE	20000	49500		69500	6950	52125	9040	10425	1808	1635	1200	13683	42758
R-R #1 & 70% FRN	20000	49500	4310	73810	6950	55358	9600	11503	1995	693	1200	13488	42149
96 SQM SEMI-DETACH													
STD & 60% FURNCE	17000	53000		70000	7000	52500	9105	10500	1821	1653	1440	14018	43807
R-R #1 & 70% FRN	17000	53000	3176	73176	7000	54882	9518	11294	1959	724	1440	13640	42626
75 SQM SEMI-DETACH													
STD & 60% FURNCE	17000	42000		59000	5900	44250	7674	8850	1535	1336	1120	11665	36453
R-R #1 & 70% FRN	17000	42000	3511	62511	5900	46883	8131	9728	1687	585	1120	11523	36008
54 SQM ROW													
STD & 60% FURNCE	13000	22000		35000	3500	26250	4552	5250	910	835	810	7108	22212
R-R #1 & 70% FRN	13000	22000	2841	37841	3500	28381	4922	5960	1034	459	810	7224	22576
38.4 SQM APT													
STD & 60% FURNCE	8000	13000		21000	2100	15750	2731	3150	546	575	290	4143	12946
R-R #1 & 70% FRN	8000	13000	1547	22547	2100	16910	2933	3537	613	378	290	4213	13167
91 SQM PRE-BUILT													
STD & 60% FURNCE	17000	37000		54000	5400	40500	7024	8100	1405	2335	1365	12128	37901
R-R #1 & 70% FRN	17000	37000	1542	55542	5400	41657	7224	8486	1472	1179	1365	11240	35124

TABLE 6.3

An examination of Table 6.2 shows that, with the exception of the row house and apartment units, the cash flow during the first year is less for the house with the added energy efficiency. Table 6.3 giving the cash flow for the third year shows that the saving margins increase, but remain slightly negative for the row and apartment units.

The cash flow associated with the higher level of energy efficiency would be higher during year one if the purchaser had to increase the down payment to cover ten percent of the incremental energy efficiency cost. For detached houses the cash flow savings is about $200 during the first year while that added down payment would be over $400.

6.2 Financing Mechanisms

As seen in Section 6.2, given the present information and assumptions about energy efficiency investment at Tumbler Ridge, the financing problem is not as severe as anticipated a few months ago. It appears that propsective purchasers will be able to opt for the Retrofit-Ready level of energy efficiency with no incremental out-of-pocket expenditure.

6.2.1 Financing the Ffficiency without Increasing the Down Increment Payment

Even in the first year, the fuel savings can pay to the financing costs. Therefore the only cash flow impact is a possible increase in the down payment. This can be avoided if the financial institution or company providing the second mortgage agrees to finance 100 percent of the energy efficiency increment. This could be done by the financial institution with or without the encouragement of CMHC. CMHC may have to relax its requirements to

allow financial institutions to allow the slightly lower down payment as a percent of total cost including the incremental energy efficiency costs. A second approach would be to require a higher percentage down payment on homes which did not have the Retrofit-Ready level of energy efficiency. Yet another approach would be to exclude the cost of the incremental energy efficiency investment when computing the required down payment.

6.2.2 Combining Multiple Ffficiency Increments

One additional technique employed in the above analysis is the comparison of the optimal level of energy efficiency (Retrofit-Ready) to the basic 1975 Standards level rather than to intermediate levels such as "Measures". Like most economic phenomena, increasing levels of energy efficiency at Tumbler Ridge exhibit diminishing rates of return. While the nominal internal rate of return associated with going from Standards to Retrofit-Ready is over 26 percent, this consists of a return of 47 precent for the step from Standards to Measures and a return of 19 percent for the step from Measures to Retrofit-Ready. Therefore, while financing the step from Standards all the way to Retrofit-Ready is not too difficult, financing the step from Measures to Retrofit-Ready by itself, while justified in present value terms, might be more difficult. Therefore, it is helpful to present the prospective purchaser with a package which includes the increment all the way from the Standard level to Retrofit-Ready. Then one can use the high return on the step up to Measures to help finance the additional step up to Retrofit-Ready.

6.2.3 Innovative Mortgage Instruments

A number of new mortgage instruments have been proposed and introduced in recent years. Most are in response to the fact that higher nominal interest rates associated with inflation increase the cash flow requirements of loans in the early years. The solution is usually some graduated payment mechanism which allows nominal payments to be lower in the early years and then increase along with the price level. In Canada, the financial institutions were hesitant to introduce these new financial instuments merely because high interest rates were distorting the time pattern of loan payment schedules. However, many banks introduced such instruments during the last year when mortgage renewals at the higher interest rates posed the threat of large-scale defaults.

Graduated payment mortgages are ideal for solving the type of financing problems which were anticipated at Tumbler Ridge when interest rates were high. The problem was not that the investment in higher levels of energy efficiency did not pay off, but that due to the high nominal interest rates, the total payments would be higher in the early years. Using a graduated payment approach the payments can be reduced in the early years and the higher energy cost savings in later years can pay for the higher loan payments.

Now that interest rates have subsided, graduated payment mortgages are likely to be used less frequently.

6.2.4 Separate Financing of Incremental Energy Efficiency Costs

By separating the incremental energy investment from the house financing package, there is less likelihood that a financial institution or a private investor will be interested in providing a loan. For one thing, because the amount of the loan is not large, it is unlikely that an investor would be as willing to review an application and handle all the administration requirements of a loan. Assuming that an investor was interested in financing separately, he would require either a third mortgage or some other form of collateral before he could approve a loan. From our discussions with lenders, the clear preference is for these costs to be financed as part of an overall financing package.

6.2.5 Subsidies to Encourage Energy Efficiency Investment

The subsidy approach is nearly universal in government energy conservation programs either in the form of a grant (e.g. The Canada Oil Substitution Program and The Canadian Home Insulation Program) or a below market interest rate (e.g. The Saskatchewan Home Energy Loan Program and The City of Portland Energy Conservation Project).

A grant equal to ten percent of the cost of the energy efficiency investment would offset the additional down payment requirements encountered in the first year. This is a useful option since (1) it requires a relatively small payment, (2) it addresses the main impediment to the investment, and (3) it creates an incentive by enabling participants to receive something from the government.

An interest rate subsidy seems inappropriate in this case because once the cash flow problem of the added down payment is taken care of the high return of the investment covers financing costs even with interest rates as high as 17 percent. If interest rates should return to high levels, the interest free loan provided by the B.C. Home Program should maintain the positive cash flow of the energy efficiency investment.

6.2.6 Loans or Collections by Utilities

Utilities have been involved in financing other energy conservation initiatives. Gas companies have helped to finance conversions from fuel oil to natural gas and insulation programs. In addition, utilities have provided a collection service by including loan payments in their billings.

This approach has two advantages. First, since the savings take the form of reduced utility bills, the loan payments should be able to be met without increasing the total utility payment above what it would have otherwise been. Second, when an energy saving investment is made at a time other than the time of purchase, utility bills represent a convenient mechanism for collecting payments. It avoids the necessity of another set of bills, cheques and stamps.

Since the energy efficiency investment at Tumbler Ridge is occuring at the time of house purchase, it is probably simplest to include the financing with the house mortgage instead of as part of the utility company billing. This simplifies the process of taking security.

6.2.7 Requiring Energy Efficiency as Condition of Government Benefits

Either the Provincial or Federal governments could require the Retrofit-Ready level of energy efficiency as a condition for government benefits. Such conditons could be attached to the Federal Grant program, CMHC guarantee programs, or the B.C. Home Program. Such a requirement seems justified since the return on the investment is so high.

6.2.8 Mining Company Financing

Mining companies have traditionaly helped their employees finance their homes, usually through low interest second mortgages. This practice has been disrupted by the suggested changes in taxing these benefits contained in the Federal budget in November 1981. Generally, mining companies want to encourage their employees to invest in energy efficiency which is economically justified. They could facilitate energy efficiency investment at Tumbler Ridge by offering larger second mortgages which covered the entire incremental investments and thereby eliminated the down payment cash flow problem mentioned above.

7.0 SUMMARY AND CONCLUSIONS

This study has addressed two principal questions related to energy efficient housing at Tumbler Ridge. The first question is what level of energy efficiency investment is economically justified. Of the three levels of energy efficiency above the standard building code requirements, the Retrofit-Ready level is shown by the economic analysis in Section 4 to be preferred. This result holds over a wide range of assumptions about costs and benefits.

The second question addressed in this study is how can the appropriate level of energy efficiency be financed so that the difficult financial climate does not discourage a profitable and socially desirable investment. While the financial climate is not as difficult as when this study started, it is necessary to finance 100 percent of the incremental cost (i.e., not increase the down payment) in order for the investment to have a positive cash flow right from the start. The can be done by a larger second mortgage from the lending institution, mining company, or government.

A number of financing mechanisms are discussed in the report which could be called on if (1) interest rates go back up, (2) future energy price forecasts are revised down, or (3) the costs of building in higher energy efficiency levels goes up.

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POOR

QUALITY

ORIGINAL